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RESEARCH ARTICLE

Composition and structure of the frugivorous butterfly community (Lepidoptera: Nymphalidae) at the Serra Azul State Park (PESA), Mato Grosso, Brazil

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ABSTRACT. Due to the important ecological role of Nymphalidae as consumers of fermented fruits, excrement, exudates of decomposed plants and animals, as well as bioindicators of environmental quality that attract the interest of the general public, this study aimed to characterize the fauna of frugivorous butterflies at the Serra Azul State Park – PESA (Mato Grosso, Brazil) with regards to composition, taxonomic richness and spatial distribution. Collections were carried out in 2014 from six 250 m plots in a RAPELD module (5x5 km). We defined five sampling points in each plot and placed a Van Someren-Rydon trap (VSR), with a bait made from banana fermented in cane juice, positioned 1 m above the ground for 24 hours. We collected 204 specimens of Nymphalidae from five subfamilies, 22 genera, and 40 species. Satyrinae was the most abundant and species-rich subfamily. The community structure varied spatially, with the gallery forest presenting the greatest richness, diversity, and equitability, while 'cerrado ralo' presented higher abundance and less diversity and equitability. Therefore, according to the pattern of abundance in the PESA, species were best adapted to the log series model. *Yphthimoides renata* (Stoll, 1780) (Satyrinae), *Hamadryas feronia* (Linnaeus, 1758), and *Callicore sorana* (Godart, 1824) (Biblidinae) were the most abundant species, 19 species were singletons, and eight were doubletons. Richness estimators showed that 63% of all species were sampled. Our results indicate that the frugivorous butterfly community is structured according to phytophysiognomies, and the dominance of species that are tolerant to disturbances indicates landscape fragmentation within the PESA, which interferes with species substitution pattern and their abundances in different environments of the park.

KEY WORDS. Cerrado, conservation, inventory, Nymphalidae, Phytophysiognomy.

INTRODUCTION

Research about conservation monitoring and planning is most effective when supported by prior knowledge about the distribution of organisms and patterns of occurrence within an area. Such information is collected through biodiversity inventories, which provide important information for restoration, composition maintenance, and structure and function of biological communities (Bellaver et al. 2012, Martins et al. 2017a, Pérez et al. 2017) in different regions. In the Brazilian Cerrado, documenting and understanding the fauna is an urgent task, since habitat loss and fragmentation has rapidly increased during the past few decades in central Brazil, resulting in more endangered species and a loss of species richness at the local and regional scales (Brannstrom et al. 2008, Klink and Machado 2005, Santos et al. 2017).

Arthropods are useful ecological indicators due to their great diversity and abundance, ease of collection, and rapid responses to environmental changes (Leivas and Fischer 2008, Lewinsohn et al. 2005, Marques et al. 2010, 2016, Soares et al. 2012). Among

the arthropods, butterflies are the most taxonomically well known in the Neotropical region (Bonebrake et al. 2010).

Furthermore, frugivorous Nymphalidae butterflies stand out in environmental monitoring and evaluation studies due to their biological and ecological characteristics, since they depend on specific micro-habitats and adequate resources to survive (Martins et al. 2017b). Thus, changes in habitat quality caused by deforestation, fire, and global climate change affect butterfly populations. The short life cycles of frugivorous butterflies also make them useful organisms for biomonitoring (Uehara-Prado and Ribeiro 2012, Pérez et al. 2017, Pinheiro et al. 2008).

Using frugivorous butterflies in ecological studies has methodological and sampling advantages, since simple traps, which are easily made and maintained, are used in field collections (Pinheiro et al. 2008). Furthermore, these butterflies are considered flagships by the scientific community, representing the environmental cause and capturing the public interest, as well as demonstrating the importance of species conservation in the ecosystems where humans live (Bonebrake et al. 2010, DeVries and Walla 2001). However, relevant information, such as local and regional inventories, is still needed to generate knowledge about the richness, abundance, and distribution, as well as data about ecological relationships in communities, such as host associations or responses to abiotic components in a region (DeVries and Walla 2001).

The state of Mato Grosso is potentially highly biodiverse because three of the main Brazilian biomes are present within its borders: Amazon tropical rainforest, Cerrado, and Pantanal. However, the frugivorous butterfly fauna in Brazil is still poorly contemplated in most inventories (Santos et al. 2008, Silva et al. 2015), especially in the central western and eastern regions of Mato Grosso (Queiroz-Santos et al. 2016).

Furthermore, the ecological importance and status of frugivorous butterflies as bioindicators were so far poorly considered in studies carried out in the region (Uehara-Prado et al. 2007, 2009). Knowledge about Mato Grosso butterflies is fragmentary and information is scattered across various sources (Santos et al. 2008, Queiroz-Santos et al. 2016).

In this context, this study aims to increase knowledge and fuel the discussion about the importance of services provided by Serra Azul State Park (PESA) in preservation and public use by maintaining the ecological functions and high biological diversity of the Cerrado. In addition, there is a lack of knowledge about the Cerrado biodiversity, which highlights the importance of understanding the biology and taxonomy of terrestrial invertebrates, especially for groups of poorly studied arthropods, helping future studies that aim to select criteria and biological models for conservation of this biome. Herein, we (1) inventoried the frugivorous butterfly fauna at PESA, (2) described the ecological metrics of the communities, and (3) analyzed the community composition in relation to the phytophysiognomies in the study area.

MATERIAL AND METHODS

The study area is located in the Serra Azul State Park (PESA) in the municipality of Barra do Garças, eastern region of the state of Mato Grosso (15°51'S, 51°16'W), with an area of approximately 11,000 ha and an altitude between 350 m and 750 m above sea level (Santos et al. 2017) (Fig. 1). The collections were carried out during January 2014 from a RAPELD module (Magnusson et al. 2005) located inside the PESA. The module comprises two five-kilometer lines, each one divided into five plots consisting of transects of 250 m in length, separated by about 1 km, totalizing 10 plots. Six of these plots were used in this study (Table 1).

Table 1. Geographic coordinates and phytophysiognomies of the plots in the RAPELD module installed in the Serra Azul State Park (PESA), Barra do Garças, Mato Grosso, Brazil.

Plots	Coordinates	Phytophysiognomy
1	15°50'58,7"S; 52°15'47"W	Cerrado sensu stricto
3	15°50'22,2"S; 52°14'49"W	Gallery forest
5	15°49'42,5"S; 52°13'49"W	Cerrado ralo – open savanna
6	15°51'07,6"S; 52°14'49"W	Deciduous forest
8	15°50'33,5"S; 52°13'56"W	Cerrado sensu stricto
10	15°49'53,8"S; 52°13'05"W	Cerrado ralo – open savanna

The PESA plots were characterized according to their vegetation type (phytophysiognomy) following the protocol from the Research Program on Biodiversity (PPBio) with standardized adaptations by the ComCerrado Network. Of our six plots, four presented Cerrado phytophysiognomies, Cerrado sensu stricto, and 'cerrado ralo' (open savannah with sparse trees), with different tree densities (356 to 1,463 individuals (Δ) Ha^{-1}). The other two plots were characterized as gallery forest (684 Δ Ha^{-1}) and deciduous forest (586 Δ Ha^{-1}) (Table 1). In the Cerrado plots, vegetation height varied from 1.0 to 13 m, while in the gallery and deciduous forests vegetation height varied between 2.2 and 25 m. The most common phytophysiognomies in the PESA module were low density woody elements and the species distribution pattern was probably related to the substrata where they develop (Maryland S. Lacerda, unpublished data).

For the collections, we defined five sampling points (100 m^2) in each plot spaced 50 m apart from each other. At each sampling point we installed a Van Someren-Rydon (VSR) trap (Rydon 1964), made up of a cylindrical thin-film cone (black tulle) (110 cm high by 35 cm diameter) closed at the top with thin white fabric and a 20 cm bottom opening, where butterflies can enter. A total of 30 traps were installed in the vegetation, approximately one meter above the ground. Each trap contained a bait made of banana fermented in cane juice, which remained in the field for 24 hours. Total sampling effort was 720 hours.

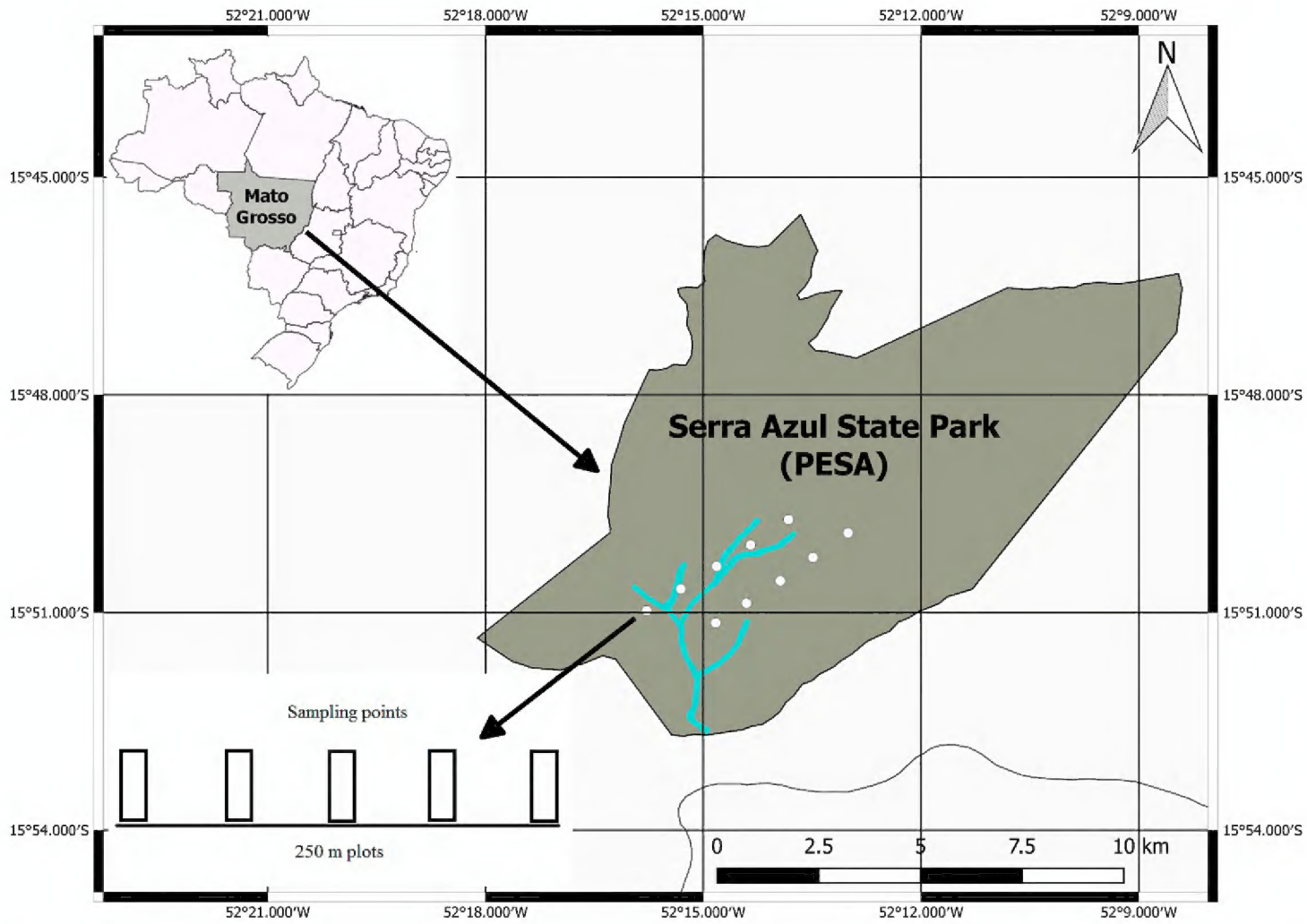

Figure 1. Location of the Serra Azul State Park (PESA), Barra do Garças, Mato Grosso, Brazil. Study area showing the RAPELD module transects with delimitation of RAPELD module with five sampling points (100 m²) spaced 50 m apart from each other.

All specimens were individually wrapped in silk paper envelopes, labeled, and mounted on a wooden stretcher with entomological pins. Specimens were then dried in an oven at 40°C for three days, labeled, and deposited at the Entomological Reference Collection of the Departmento de Biologia, Universidade Federal de Mato Grosso, Campus Universitário de Rondonópolis (DBFR). Identifications were made based on specific literature (Lamas 2004, Uehara-Prado et al. 2004, Freitas et al. 2012, Seraphim et al. 2014) and confirmed by the fifth author and Dr Amabílio José A. de Camargo (EMBRAPA Cerrado, Brasília, DF), specialists in Lepidoptera.

We calculated the absolute richness and relative frequency of each species in each phytophysiognomy. To describe the community of frugivorous butterflies in the sampled areas, we used the diversity indices of Shannon-Wiener (H'), Pielou equitability (J), and Chao species richness estimator, as well as a rarefaction curve. Shannon-Wiener index was compared using t-test. The pattern of species abundance was tested in relation to the four predictive models (broken-stick, log normal, log series, and geometric). To verify if species composition differed with the phytophysiognomies, we performed a non-metrical dimensional scaling (NMDS – Bray Curtis similarity index). Similarity percentage (SIMPER) was used to assess which taxa were most responsible for the similarity between samples. Seriation test was used to order the species in the localities, presuming the faunal gradient for reorganizing the data matrix when the presences of the species are concentrated along the diagonal gradient, with the 'Monte Carlo' simulation. All analyses were performed in the Past® program and Sigmaplot® was used for graphic construction.

RESULTS

We obtained a total of 204 individuals of Nymphalidae, distributed in five subfamilies, 22 genera, and 40 species. Satyrinae presented the highest abundance, number of genera, and number of species, and Biblidinae presented the second largest abundance. The most dominant species were *Yphthimoides renata* (Stoll, 1780) (N = 77, 37.75%), *Hamadryas feronia* (Linnaeus, 1758) (N = 30, 14.71%), and *Callicore sorana* (Godart, 1824) (N = 10, 4.9%) (Table 2).

The species abundance pattern was best fit to the log series model (alpha = 14.9, $\chi^2 = 111$, $p < 0.001$; Broken stick: $\chi^2 = 185.4$, $p = 0.003$; Geometric: $\chi^2 = 541.8$, $p = 0.009$; log-normal distribution: $\chi^2 = 2.25$, $p = 0.32$) (Fig. 2). The log-series model explains the presence of a few dominant species and a large number of rare species, influenced by the high abundance of *Y. renata* and *H. feronia*. Of the least abundant species, 19 species were singletons and eight doubletons, representing about 67% of the total observed richness. The cerrado ralo presented the highest abundance of Nymphalidae (N = 92), followed by the Cerrado sensu stricto (N = 61), gallery forest (N = 30), and deciduous forest (N = 21) (Table 2).

Table 2. Abundance (N) and relative frequency (%) of the subfamilies and species of Nymphalidae sampled from the four phytophysiognomies in the Serra Azul State Park (PESA), Barra do Garças, Mato Grosso, Brazil.

Nymphalidae	Cerrado sensu stricto		Gallery forest		Deciduous forest		Cerrado ralo		Total	
	(N)	(%)	(N)	(%)	(N)	(%)	(N)	(%)	(N)	(%)
Biblidinae	33	16.17	4	1.96	2	0.98	13	6.37	52	25.49
Callicore sorana (Godart, 1824)	8	3.92	0	0.00	2	0.98	0	0.00	10	4.90
Catonephele acontius (Linnaeus, 1771)	1	0.49	1	0.49	0	0.00	0	0.00	2	0.98
Hamadryas amphinome (Linnaeus,1767)	0	0.00	0	0.00	0	0.00	1	0.49	1	0.49
Hamadryas februa (Hubner, 1823)	3	1.47	0	0.00	0	0.00	2	0.98	5	2.45
Hamadryas feronia (Linnaeus, 1758)	21	10.29	0	0.00	0	0.00	9	4.41	30	14.71
Nica flavilla (Godart, 1824)	0	0.00	3	1.47	0	0.00	0	0.00	3	1.47
Temenis laothoe (Cramer, 1777)	0	0.00	0	0.00	0	0.00	1	0.49	1	0.49
Charaxinae	5	2.45	6	2.94	2	0.98	2	0.98	15	7.35
Archaeoprepona demophon (Linnaeus, 1758)	0	0.00	1	0.49	0	0.00	0	0.00	1	0.49
Archaeoprepona sp.	0	0.00	1	0.49	0	0.00	0	0.00	1	0.49
Archeoprepona amphimachus (Fabricius, 1775)	0	0.00	1	0.49	1	0.49	0	0.00	2	0.98
Memphis moruus (Fabricius, 1775)	1	0.49	1	0.49	0	0.00	0	0.00	2	0.98
Prepona laertes (Hübner, 1811)	0	0.00	1	0.49	0	0.00	1	0.49	2	0.98
Prepona pheridamas (Cramer, 1777)	0	0.00	1	0.49	1	0.49	0	0.00	2	0.98
Siderone galanthis (Cramer, 1775)	4	1.96	0	0.00	0	0.00	1	0.49	5	2.45
Heliconiinae	0	0.00	1	0.49	0	0.00	0	0.00	1	0.49
Heliconiinae sp.	0	0.00	1	0.49	0	0.00	0	0.00	1	0.49
Nymphalinae	0	0.00	2	0.98	0	0.00	0	0.00	2	0.98
Colobura dirce (Linnaeus, 1758)	0	0.00	2	0.98	0	0.00	0	0.00	2	0.98
Satyrinae	23	11.27	17	8.33	17	8.33	77	37.75	134	65.68
Amphidecta calliomma (Felder &Felder, 1862)	0	0.00	0	0.00	1	0.49	0	0.00	1	0.49
Amphidecta reynoldsi (Sharpe, 1890)	0	0.00	0	0.00	1	0.49	0	0.00	1	0.49
Caligo brasiliensis (Felder 1862)	1	0.49	0	0.00	0	0.00	0	0.00	1	0.49
Chloreuptychia arnaca (Fabricius, 1776)	0	0.00	3	1.47	0	0.00	0	0.00	3	1.47
Cissia myncea (Cramer, 1780)	0	0.00	4	1.96	2	0.98	1	0.49	7	3.43
Cissia sp.	0	0.00	2	0.98	0	0.00	0	0.00	2	0.98
Hermeuptychia hermes (Fabricius, 1775)	3	1.47	0	0.00	1	0.49	0	0.00	4	1.96
Morpho helenor achillides Felder & Felder 1867	0	0.00	1	0.49	0	0.00	0	0.00	1	0.49
Opsiphanes invirae (Hübner, 1808)	4	1.96	0	0.00	0	0.00	2	0.98	6	2.94
Paryphthimoides undulata (Butler, 1867)	1	0.49	0	0.00	0	0.00	0	0.00	1	0.49
Posttaygetis penelea (Cramer, 1777)	0	0.00	0	0.00	1	0.49	0	0.00	1	0.49
Satyrini sp. 1	0	0.00	1	0.49	0	0.00	0	0.00	1	0.49
Satyrini sp. 2	0	0.00	1	0.49	0	0.00	0	0.00	1	0.49
Satyrini sp. 3	0	0.00	0	0.00	0	0.00	1	0.49	1	0.49
Taygetina oreba (Butler, 1870)	0	0.00	0	0.00	2	0.98	2	0.98	4	1.96
Taygetis acuta Wetmer, 1910	0	0.00	1	0.49	0	0.00	1	0.49	2	0.98
Taygetis cleopatra Felder & Felder, 1867	0	0.00	1	0.49	0	0.00	0	0.00	1	0.49
Taygetis mermeria (Cremer, 1776)	0	0.00	0	0.00	4	1.96	1	0.49	5	2.45
Taygetis rufomarginata Staudinger, 1888	0	0.00	1	0.49	0	0.00	0	0.00	1	0.49
Taygetis sp.	0	0.00	1	0.49	0	0.00	0	0.00	1	0.49
Taygetis virgilia (Cramer, 1776)	0	0.00	0	0.00	0	0.00	1	0.49	1	0.49
Yphthimoides pacta (Weymer, 1911)	1	0.49	0	0.00	0	0.00	6	2.94	7	3.43
Yphthimoides renata (Stoll, 1780)	12	5.88	1	0.49	5	2.45	59	28.92	77	37.75
Yphthimoides sp.	0	0.00	0	0.00	0	0.00	1	0.49	1	0.49
Total	61	30.00	30	15.00	21	10.00	92	45.00	204	100.00

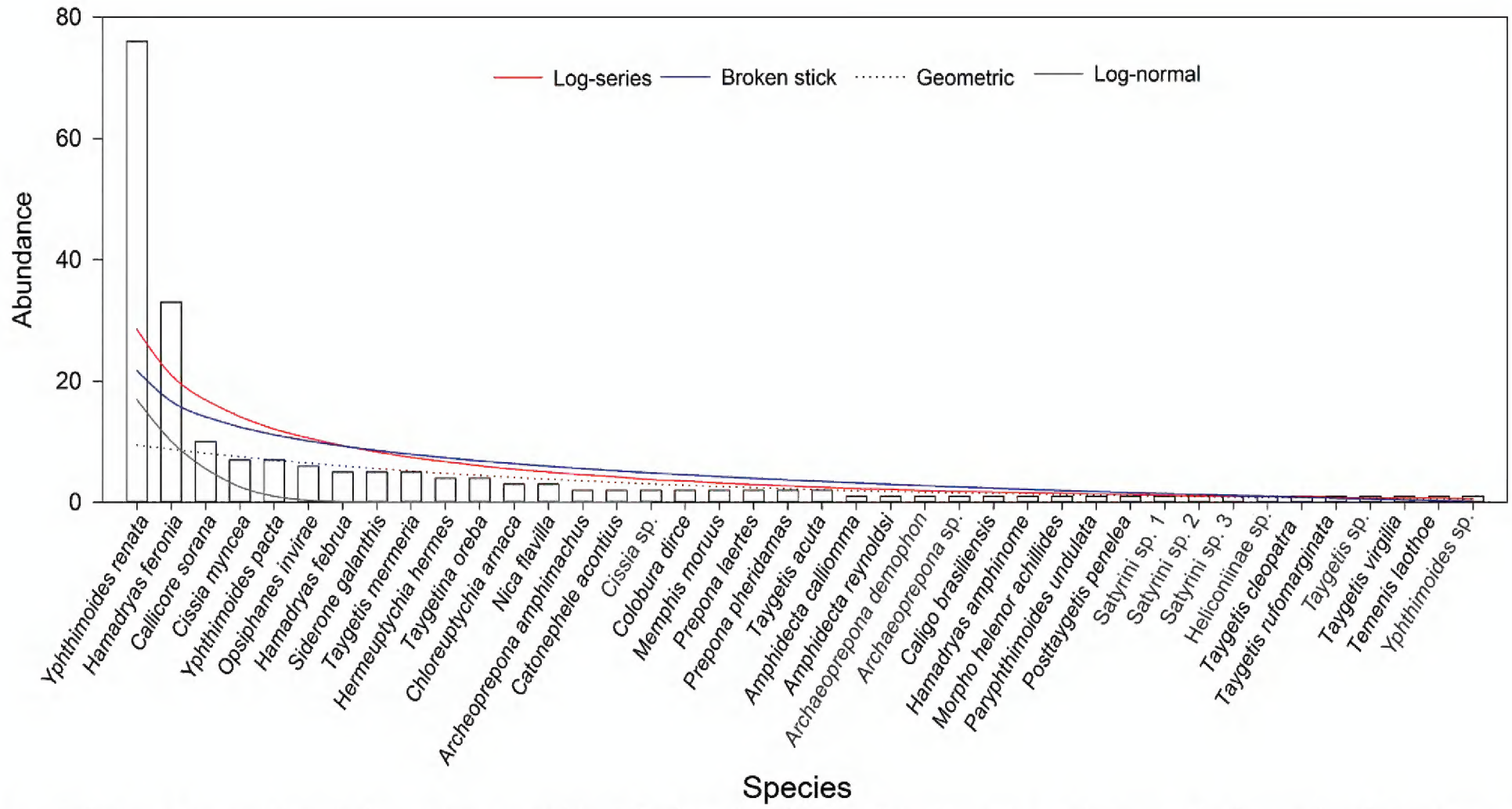

Figure 2. Abundance of Nymphalidae species sampled at the Serra Azul State Park (PESA). Barra do Garças, Mato Grosso, Brazil. Abundance model fits to log serial distribution (alpha = 14.9, χ^2 = 111, $p < 0.05$).

According to the Chao2 richness estimator we expected to find 65 (± 15) species in the sampled area. However, only ~63% of the estimated species richness was sampled (82% to 51% considering the SD of the estimator) (Fig. 3). The richest phytophysiognomy was the gallery forest, followed by cerrado ralo, Cerrado sensu stricto, and deciduous forest (Table 3). The diversity and equitability index showed that the gallery forest was the most diverse and equitable, followed by the deciduous forest, Cerrado sensu stricto, and cerrado ralo, being statistically significant between Cerrado sensu stricto and gallery forest and gallery forest and deciduous forest (Table 3). Among the species sampled, 16 of them were responsible for more than 80% of the similarity between the areas, and four of these were responsible for more than 50% of the similarity, with *Y. renata* accounting for

Figure 3. Rarefaction curve (± SD) of Nymphalidae species richness sampled at the Serra Azul State Park (PESA), Barra do Garças, Mato Grosso, Brazil.

Table 3. Ecological metrics of Nymphalidae in phytophysiognomies of the Serra Azul State Park (PESA), Barra do Garças, Mato Grosso, Brazil. Richness (S), Abundance (N), Shannon index (H'), Pielou equitability (J), and species richness estimator (Chao-2). Shannon diversity t test index (H') comparison among phytophysiognomies. Blank cell: t-test result. Bold: p values.

Phytophysiognomies	S	N	H'	J	Chao-2
Cerrado sensu stricto	12	61	1.945	0.7826	22
Cerrado ralo	16	91	1.469	0.5299	27
Deciduous forest	11	22	2.199	0.9171	15
Gallery forest	21	30	2.904	0.9539	61
Shannon diversity t	t/p	CR	C	GF	DF
	CR	–	**0.29**	**0.250**	**0.18**
	C	1.06	–	**0.03***	**0.77**
	GF	-1.16	2.19	–	**0.02***
	DF	1.35	-0.29	2.47	–

CR: Cerrado ralo, C: Cerrado sensu strict, GF: Gallery forest, DF: Deciduous forest. *Statistical significance.

28.94%, *H. feronia* 14.17%, *C. sorana* 5.99%, and *Cissia myncea* (Cramer, 1780) 5.1% (Table 4).

Table 4. Individual and cumulative contribution of species to the similarity of Nymphalidae community composition in the Serra Azul State Park (PESA), Barra do Garças, Mato Grosso, Brazil.

Species	Contribution (%)	
	Individual	Cumulative
Yphthimoides renata	28.94	28.94
Hamadryas feronia	14.17	43.11
Callicore sorana	5.99	49.10
Cissia myncea	5.21	54.31
Taygetis mermeria	3.40	57.71
Chloreuptychia arnaca	3.04	60.75
Opsiphanes invirae	2.87	63.62
Yphthimoides pacta	2.64	66.26
Siderone galanthis	2.46	68.72
Taygetina oreba	2.24	70.96
Hermeuptychia hermes	2.08	73.04
Hamadryas februa	1.82	74.86
Archeoprepona amphimachus	1.72	76.58
Prepona pheridamas	1.69	78.28
Cissia sp.	1.57	79.85
Catonephele acontius	1.51	81.36

The frugivorous butterfly community presented different species compositions among the phytophysiognomies (Stress = 0.17, R^2 = Axis 1 = 0.42 and Axis 2 = 0.22). The largest difference occurred between the Cerrado phytophysiognomies (Cerrado sensu stricto and cerrado ralo) and the gallery forest. The deciduous forest presented species from both the Cerrado and the gallery forest (Fig. 4). There was a substitution of species occurrence in relation to the phytophysiognomies (Criterion 0.38, Z score: -2.034, $p < 0.05$) (Fig. 5).

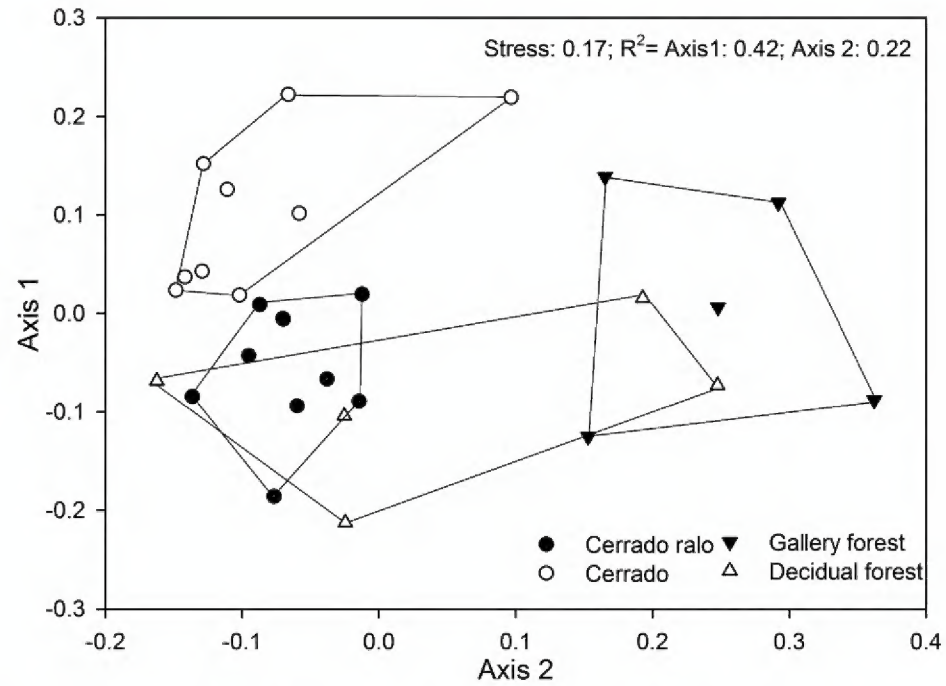

Figure 4. Non-metric dimensional scaling of Nymphalidae community sampled at the Serra Azul State Park (PESA), Barra do Garças, Mato Grosso, Brazil.

DISCUSSION

Regarding richness and abundance, the most dominant subfamilies of frugivorous butterflies in the PESA were Satyrinae and Biblidinae. Furthermore, these taxa showed higher abundance and species richness in other studies from the Neotropical region (Lamas 2004, Martins et al. 2017b, Silva et al. 2012, Santos et al. 2011, Uehara-Prado et al. 2007).

The diversity of Satyrinae is related to its biology. They have diurnal habits, feed on fruits in different stages of decomposition and with fungi, have low dispersal capacity, fly near the ground, and prefer shaded areas. They are dominant members of the butterfly communities in different Neotropical (Marín et al. 2011, Paluch et al. 2016) and Cerrado phytophysiognomies in the PESA.

The complexity of interspecific or biotic interactions is considered the main reason for diversity in tropical environments, and the intimate relationships between butterflies and their host plants could help clarify the origin of butterfly megadiversity in the tropics (Bonebrake et al. 2010). In this sense, the abundance of Satyrinae was dependent on the distribution pattern of its host plants, since the larval stage of these butterflies generally develop on monocotyledons, whose growth, abundance, and nutritional content are strongly seasonal. Our samples were obtained in the rainy season, which increases food resource for butterflies. Therefore, plants are adequate resources for Satyrinae larvae, and due to such food availability for the larval stage, we observed peak recruitment of adults in these areas (Silva et al. 2007).

Our results indicate that the association of Satyrinae with monocotyledons may explain the higher abundance and dominance of certain species in the Cerrado areas, as the cerrado ralo, which is typically more open and has more monocotyledons as compared to forested areas. This was observed for *Yphthimoides* Forst, 1964, as *Y. renata* was the most abundant of the three species of *Yphthimoides* recorded in PESA. *Yphthimoides* is a Neotropical genus associated with Poaceae (Freitas 2004, Marín et al. 2011, Freitas et al. 2012, Barbosa et al. 2016). Individuals of the genus are distributed in different habitats, including open environments such as forest edges, savannas, and secondary environments (e.g., open pasture areas in urban environments), and are abundant in areas with different degrees of disturbance and anthropogenic impacts (Freitas et al. 2012, Barbosa et al. 2015, 2016).

The abundance of Biblidinae, explained by the dominance of *H. feronia* in the Cerrado sensu stricto, also reinforces the previous hypothesis since this species is associated with anthropogenically impacted areas (e.g., Martins et al. 2017b, Uehara-Prado et al. 2007).

In this way, the log-series distribution found may be indicative of the disturbed environment in the PESA, which

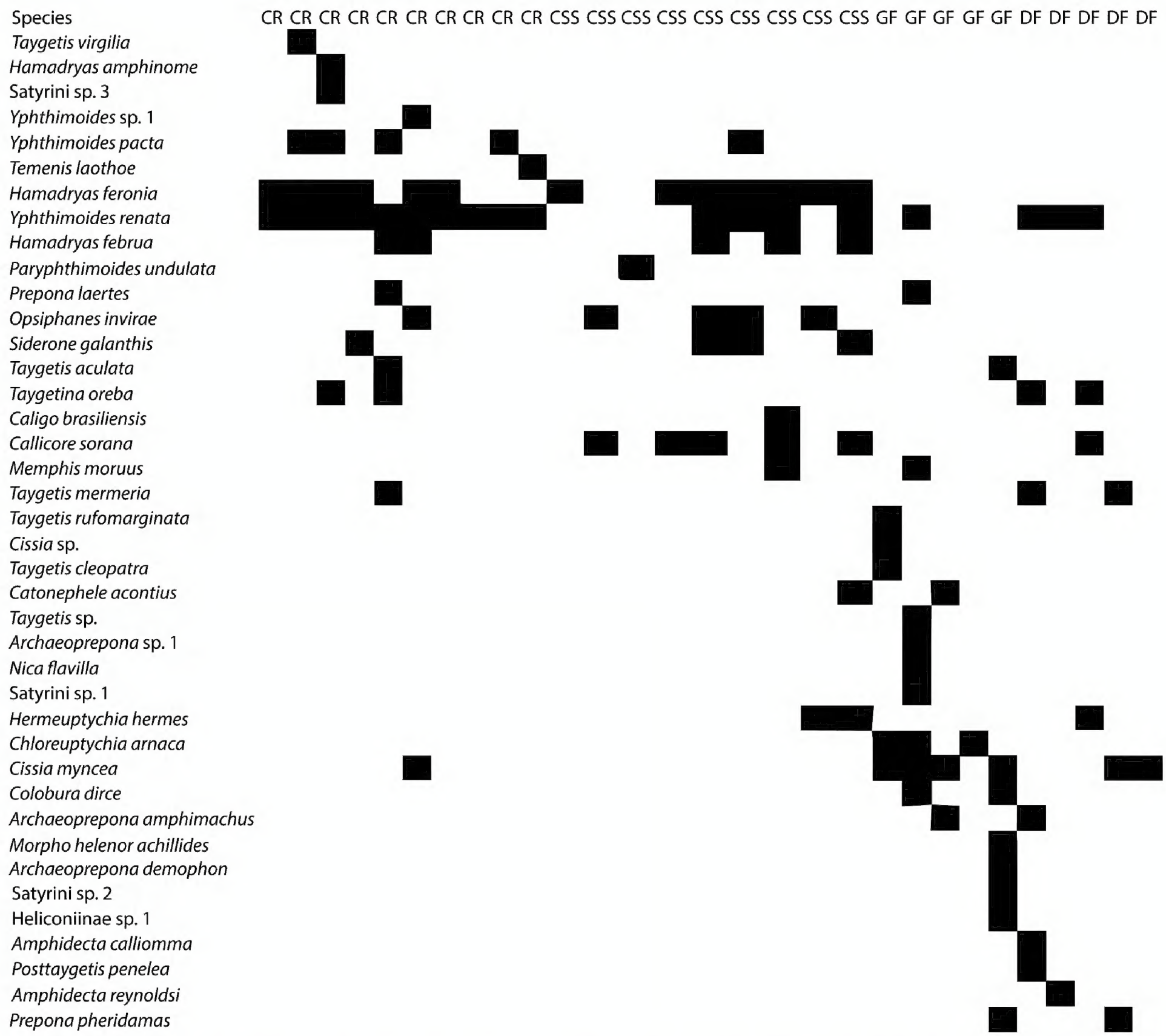

Figure 5. Nymphalidae community ordination in relation to sampled sites (CR: Cerrado ralo, C: Cerrado sensu strict, GF: Gallery forest, DF: Deciduous forest) in Serra Azul State Park (PESA), Barra do Garças, Mato Grosso, Brazil.

has a large amount of grasses, due to the region's fire history. The two most abundant species in the frugivorous butterfly community were the ones considered tolerant to anthropogenic effects, which contributed to the abundance model and to the low diversity and equitability indexes registered for the Cerrado physiognomies of the PESA. In this sense, both *Y. renata* and *H. feronia* can be considered indicators of disturbances and/or landscape fragmentation within the PESA, as observed by Martins et al. (2017b).

The occurrence of species with low abundance and the 27 rare species recorded in the PESA can be considered high when compared to inventories carried out in the areas with marginal influences of savannah, Chaco, and Pantanal (e.g., De Souza and Guillhermo-Ferreira 2015). Rare species are those that are difficult to sample because their populations are apparently very small. Besides that, these species may be considered rare in one spot, but not in others, due to differences in the availability of food resources, host plants, or microclimatic factors (Brown Jr and Freitas 2002, De Souza and Guillhermo-Ferreira 2015).

The observed richness was well below the estimated richness for the frugivorous butterfly community distributed in the PESA, demonstrating that other species could still be collected

with a larger sampling effort. When compared to other studies developed in the Cerrado (Silva et al. 2012, 2015) or predominantly forested areas (Uehara-Prado et al. 2007), the richness and/or diversity recorded for the PESA was low, but was higher than the richness/diversity recorded in fragmented areas from other regions in Brazil (Silva et al. 2007, Martins et al. 2017b).

While it is difficult to compare richness and diversity of frugivorous butterflies from different studies due to the peculiarities of each study, especially regarding differences in collection methods, sample effort and size, and disturbed and undisturbed areas (Martins et al. 2017b). A careful evaluation of species abundance in different areas can reveal, for example, changes in the composition and structure of the hostplants. Such information should be investigated in future studies for species such as *C. sorana*, *Hamadryas amphinome* (Linnaeus, 1767), *H. februa* (Hübner, [1823]), *H. feronia*, *Colobura dirce* (Linnaeus, 1758), and *Opsiphanes invirae* (Hübner, 1808), which are considered common and abundant on regional scales (Silva et al. 2015), but registered low abundances in the PESA.

Our results demonstrate that the community of frugivorous butterflies at the PESA is spatially structured, with the highest richness, diversity, and equitability in the gallery forest. However, the second largest richness and lower diversity and equitability were found in the cerrado ralo. Cerrado sensu stricto and deciduous forest showed similar ecological metrics. Such pattern may be related to periodic disturbances, such as the frequency and intensity of fires (e.g., Santos et al. 2017), which alter the floristic structure of the PESA physiognomies (e.g., Peixoto et al. 2012, Santos et al. 2017, Ribeiro et al. 2012) and, consequently, the organisms that depend on such physiognomies.

In this study, we found a significantly higher number of species in the forest with higher frequency of burning (Peixoto et al. 2012). This reinforces the differences in richness, diversity, and equitability values for the frugivorous butterfly community in the PESA phytophysiognomies, with higher values in forested areas when compared to typical Cerrado areas.

The frugivorous butterfly community in the cerrado ralo and gallery forest indicates that these phytophysiognomies are subsets of the butterfly communities in the deciduous forest, since, in terms of composition and dominance, they share the same species. Furthermore, authors such as Pinheiro and Ortiz (1992) and Emery et al. (2006) proposed that a variety of phytophysiognomies promotes a higher environmental and spatial heterogeneity for butterflies, since variations in microenvironments favor a wider range of species.

Our results confirm that frugivorous butterfly guilds are promising biological models for developing future environmental monitoring studies, and that patterns of species richness, abundance, and distribution can be used to make conservation and management decisions in the PESA and other areas. The spatial and temporal monitoring of the butterflies can be used in the selection of species for indicating the degree of degradation of the habitat.

This initial inventory can serve as a starting point for long-term monitoring of the PESA butterfly community, which could provide data to support decisions about area management. In addition, our data highlights the need for more studies in areas that have not yet been inventoried. Finally, as more species are recorded and/or discovered, information is increased and can be used for Neotropical biodiversity conservation.

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